Engineering Applications					
Course					
Engineering Applications is an engineering research course in which students work in teams to design and develop an original solution to a valid open-ended technical problem by applying the engineering design process. The course applies and concurrently develops secondary level knowledge and skills in mathematics, science, and technology. Utilizing the activity-project-problem-based (APPB) teaching and learning pedagogy, students will perform research to choose, validate, and justify a technical problem. After carefully defining the problem, teams of students will design, build, and test their solution. Finally, student teams will present and defend their original solution. While progressing through the engineering design process, students will work closely with experts and will continually hone their organizational, communication and interpersonal skills, their creative and problem solving abilities, and their understanding of the design process. Engineering Applications is a high school level course that is appropriate for 11th-12th grade students. Since the projects on which students work can vary with student interest and the curriculum focuses on problem solving, EA is appropriate for students who are interested in any STEM career path.					
Program of Study to which the course applies	**Course Code**				
STEM	103193				
		Reference Standards	**Academic Crosswalk to Common Core Standards**	**Academic Crosswalk to Nebraska Standards**	**Comments**
Standard 1	Students will identify and clarify an Engineering problem and an introduction to Problem Statement.	**EDD 2.1**			
Benchmark 1.1	Understand brainstorming is an effective technique used to generate problem statements to identified statements	EDD 2.1			

Sample Performance Indicator 1.1.1	Brainstorm problem statements for unique innovations or inventions.	EDD 2.1			
Benchmark 1.2	Recognize a concise problem statement is the foundation in solving problems.	EDD 2.1	ELA.WHST.11-12.4	LA.12.2.2.b	
Sample Performance Indicator 1.2.1	Write concise problem statements using technical writing skills.	EDD 2.1			
Benchmark 1.3	Comprehend an accurately written problem statement aids in determining if the result of the engineering design and development process has solved the identified problem.	EDD 2.1	ELA.RST.11-12.8	LA.12.1.6.d	
Sample Performance Indicator 1.3.1	Document research that justifies the problem statement for the engineering design and development project.	EDD 2.1			
Standard 2	Students will properly apply safe procedures, practices, and equipment operation.			SC.12.1.1.d	
Benchmark 2.1	Practice required safety standards according to industry.	OSHA	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2)
Sample Performance Indicator 2.1.1	Successfully complete written safety assessment.				
Sample Performance Indicator 2.1.2	Sign and abide by a safety contract.				

Standard 3	Student will demonstrate application of basic design process principles.	IED 1			
Benchmark 3.1	Use the design process to define a problem and research a solution.	IED 1	ELA.RST.11-12.3 MTH.G.MG.3	LA.12.1.6.k LA.12.3. MA.12.2.4.a MA.12.2.4.b SC.12.1.3.a	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2). Alignment presumes that students will sketch and draw geometric objects while using the design process to define and research a solution (NE:
Sample Performance Indicator 3.1.1	Apply Engineering notebook standards and protocols during documentation.				
Sample Performance Indicator 3.1.2	Gather information using various sites and resources.				
Sample Performance Indicator 3.1.3	Sketch possible solutions to problem stated.				
Sample Performance Indicator 3.1.4	Use oblique and isometric sketching techniques to represent solutions.				
Sample Performance Indicator 3.1.5	Use a list of specifications and constraints identified in a decision matrix to the stated problem.				
Benchmark 3.2	Develop a list of alternative solutions to the stated problem.	IED 4.2, NCS D4		SC.12.1.3.a	
Sample Performance Indicator 3.2.1	Sketch possible solutions to problem stated.				
Sample Performance Indicator 3.2.2	Develop a set of team norms or guidelines to follow.				

Benchmark 3.3	Apply technical sketching and drawing.	NCS D4	ELA.WHST.11-12.6 MTH.G.MG.3	MA.12.2.4.a MA.12.2.4.b MA.12.2.5.b	Alignment presumes that students will sketch geometric objects and apply appropriate units and scales for measurement (NE: MA.12.2.4.a-b, MA.12.2.5.b)
Sample Performance Indicator 3.3.1	Use oblique,isometric and multiview sketching techniques to represent the solution.				
Sample Performance Indicator 3.3.2	Use measurement and statistics.				
Sample Performance Indicator 3.3.3	Describe how engineers use universal standardized symbolic languages to communicate, such as, mathematical equations, drafting standards, American Society of Heating, Refrigerating, and Air-condition Engineers, Inc. (ASHRAE) Handbook, American National Standards Institute (ANSI) Standards, and related				
Sample Performance Indicator 3.3.4	Understand that engineered outcomes must be documented to accepted standards with precision in order to aid in avoiding unnecessary harm.				
Standard 4	Students will demonstrate basic 3D modeling software skills.	IED			

Benchmark 4.1	Use geometric and numeric constraints to define the shape and size of objects in Computer Aided Design (CAD) modeling systems.	IED 1.4	MTH.G.MG.3	MA.12.2.4.a MA.12.2.4.b	
Sample Performance Indicator 4.1.1	Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.				
Sample Performance Indicator 4.1.2	Apply geometric and numeric constraints to CAD sketches.				
Benchmark 4.2	Design and construct a complex 3-dimensional object.	IED 1.4	MTH.G.MG.3	MA.12.2.4.a MA.12.2.4.b	
Sample Performance Indicator 4.2.1	Derive three-dimensional forms from two-dimensional shapes.				
Sample Performance Indicator 4.2.2	Brainstorm and sketch possible solutions to an existing design problem.				
Sample Performance Indicator 4.2.3	Select an approach that meets or satisfies the constraints given in a design brief.				
Sample Performance Indicator 4.2.4	Create simple extruded solid Computer Aided Design (CAD) models from dimensioned sketches.				
Standard 5	Students will produce a product/project for evaluation.	NCS 1, NCS 3			

Benchmark 5.1	Logically segment problems and opportunities from an engineering perspective to derive effective solutions (use Engineering Design Process).	NCS 3		SC.12.1.3.a SC.12.1.3.b SC.12.1.3.c SC.12.1.3.d SC.12.1.3.e	
Sample Performance Indicator 5.1.1	Use engineering notebook documentation or worksheet to log the Engineering Design Process (1. Define the problem. 2. Research the problem. 3. Create possible solutions. 4. Choose the best solution. 5. Create a prototype. 6. Test and evaluate. 7. Communicate. 8. Redesign.)				
Sample Performance Indicator 5.1.2	Brainstorm and discuss the product process.				
Sample Performance Indicator 5.1.3	Create a flowchart of the product process.				
Benchmark 5.2	Create a product on the computer.	CIM 2.3	ELA.RST.11-12.3 MTH.G.MG.1 MTH.G.MG.3	LA.12.1.6.k LA.12.3.2 MA.12.2.4.a MA.12.2.4.b	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 5.2.1	Model product/project on computer in 2D.				
Sample Performance Indicator 5.2.2	Model product/project on computer in 3D.				

Benchmark 5.3	Create parts using available equipment as demonstrated by the instructor.	CIM 2.3	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).
Sample Performance Indicator 5.3.1	Prototype [create] product/project using common office supplies.				
Benchmark 5.4	Prototype [create] product/project using hand tools.		ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2)
Sample Performance Indicator 5.4.1	Prototype [create] product/project using 3D printer.				
Sample Performance Indicator 5.4.2	Plot the product/project.				
Standard 6	Students will apply basic mathematic principles.	POT			
Benchmark 6.1	Use a systems approach to investigate mechanical, fluid, electrical, and thermal systems.	POT 1-12			
Sample Performance Indicator 6.1.1	Apply the universal systems model to technological activities.				
Sample Performance Indicator 6.1.2	Identify the inputs, processes, outputs, and feedback associated with each of the systems.				
Benchmark 6.2	Work safely with mechanical, fluid, electrical, and thermal technology.	POT 1-2, 9, 6, 12	ELA.RST.11-12.3	LA.12.1.6.k LA.12.3.2	Alignment presumes that students must comprehend oral or written instructions to complete the task (CC: ELA.RST.11-12.3; NE: LA.12.1.6.k, LA.12.3.2).

Sample Performance Indicator 6.2.1	Make prudent choices in the conservation and use of resources and the disposal of materials.				
Benchmark 6.3	Apply communication, science, and mathematics knowledge and skills.		MTH.A.REI.3	MA.12.1.3.d MA.12.2.5.d SC.12.1.1.j SC.12.1.1.l	Benchmark implies a wide variety of language arts skills, depending on the specific indicators and activities used. Alignment presumes that students will perform unit conversions and select and apply appropriate methods of computation (NE: MA.12.1.3.d, MA.12.2.5.d), as well as solving linear equations in one variable (CCSS: MTH.A.REI.3), as part of applying
Sample Performance Indicator 6.3.1	Prepare technical reports and presentations.				
Sample Performance Indicator 6.3.2	Solve algebraic equations.				
Sample Performance Indicator 6.3.3	Perform unit conversions.				
Standard 7	Students will apply basic physics principles.	POT 1-4, 8			
Benchmark 7.1	Explore the laws governing motion.	POT 8	MTH.A.CED.1 MTH.A.REI.3 MTH.N.VM.3	MA.12.3.1.f MA.12.3.2.a SC.12.1.1.l SC.12.2.2.a SC.12.2.2.b SC.12.2.2.c SC.12.2.2.d	Alignment presumes that students will use equations, graphs, and vectors to describe motion when exploring the laws governing motion (CCSS: MTH.A.CED.1, MTH.A.REI.3, MTH.N.VM.3; NE: MA.12.3.1.f, MA.12.3.2.a)

Sample Performance Indicator 7.1.1	Analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion.	POT			
Sample Performance Indicator 7.1.2	Generate and interpret graphs describing motion, including the se of real time technology.	POT			
Sample Performance Indicator 7.1.3	Develop and interpret a free-body diagram for force analysis.	POT			
Benchmark 7.2	Describe forces, energy, and power.	POT 1	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.1.1.g SC.12.2.2.c	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a). Alignment presumes that students will make predictions based on balanced and unbalanced forces and analyze the conceptual relationships of force, energy and power (NE: SC.12.1.1.g, SC.12.2.2.c)
Sample Performance Indicator 7.2.1	Analyze the relationship among force, energy, power, pressure, voltage, and temperature.	POT			
Sample Performance Indicator 7.2.2	Evaluate and predict what happens to an object when forces on it are balanced and when forces on it are unbalanced.	POT			

Benchmark 7.3	Explore the concept of resistance.	POT 4	MTH.N.Q.1	MA.12.2.5.b MA.12.2.5.d SC.12.2.3.j SC.12.2.3.f SC.12.2.3.d	Alignment presumes that students will apply and convert appropriate units when measuring resistance (NE: MA.12.2.5.b, MA.12.2.5.d). Alignment presumes that students will evaluate thermal and electrical energy, as well as the law of conservation of energy as it relates to changes in resistance within these types of systems (NE: SC.12.2.3.j, SC.12.2.3.f,
Sample Performance Indicator 7.3.1	Identify resistance in mechanical, fluid, electrical, and thermal energy systems.	POT			
Sample Performance Indicator 7.3.2	Measure, verify, and analyze resistance in mechanical, fluid, electrical, and thermal energy systems	POT			
Benchmark 7.4	Describe the uses and forms of energy.	POT	ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.2.3.d SC.12.2.3.i SC.12.2.4.j	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a). Alignment presumes that students will identify and relate potential, kinetic, and heat energy to the conservation of energy (NE: SC.12.2.3.d, SC.12.2.3.i, SC.12.2.3.j).
Sample Performance Indicator 7.4.1	Identify the nature of energy;	POT			

Sample Performance Indicator 7.4.2	Relate potential energy, kinetic energy, and heat energy to the conservation of energy.	POT			
Benchmark 7.5	Describe power as it relates to engineering problems and the design process.		ELA.WHST.11-12.2.b ELA.SL.11-12.4	LA.12.2.1.b LA.12.3.1.a SC.12.2.3.d SC.12.2.3.f SC.12.2.3.j	When students *describe* information or ideas, they communicate their knowledge through either speaking or writing. To demonstrate full knowledge on the topic, students' presentations must include all the main ideas and relevant details on the subject (CC: ELA.WHST.11-12.2.b, ELA.SL.11-12.4; NE: LA.12.2.1.b, LA.12.3.1.a).
Sample Performance Indicator 7.5.1	Define power in mechanical, fluid, electrical, and thermal systems.	POT			
Sample Performance Indicator 7.5.2	Relate the principle of work divided by time to each energy system.	POT			
Benchmark 7.6	Illustrate energy transformation.	POT		SC.12.1.1.e SC.12.1.1.j SC.12.2.3.i SC.12.2.3.j	Alignment presumes that students will observe and explain concepts of energy transformations as they relate to kinetic and potential energy within a system (NE: SC.12.1.1.e, SC.12.1.1.j, SC.12.2.3.i, SC.12.2.3.j)
Sample Performance Indicator 7.6.1	Observe and describe examples of kinetic and potential energy in mechanical, fluid, and electrical systems.	POT			
Sample Performance Indicator 7.6.2	Compare examples of energy transformations in mechanical, fluid, and electrical systems.	POT			

Standard 8	Student will document and present proposed solution to panel.				
Benchmark 8.1	Recognize the use of presentation software allows engineers to present visual aids and project in a professional manner.	EDD 8.1	ELA.SL.11-12.5	LA.12.3.1.c SC.12.1.1.f SC.12.1.1.j SC.12.1.3.e	Alignment presumes that students will gather data, create a technical research paper, and present a display of the results (NE: SC.12.1.1.f, SC.1.1.j, SC.12.1.3.e)
Sample Performance Indicator 8.1.1	Gather data and information compiled throughout the project and create a technical research paper,presentation software, and three panel display of their design solution.	EDD 8.1			
Benchmark 8.2	Engineers develop skills in public speaking to effectively communicate their design solutions.	EDD 8.1	ELA.SL.11-12.4-6	LA.12.3.1	
Sample Performance Indicator 8.2.1	Identify appropriate techniques for delivering formal presentations.	EDD 8.1			
Sample Performance Indicator 8.2.2	Orally present an effective technical presentation on the chosen design solution.	EDD 8.1			
Benchmark 8.3	Understand presentations and displays of work provide the means to effectively promote the implementations of a project.	EDD 8.1		SC.12.1.3.e	

Sample Performance Indicator 8.3.1	Update their portfolio with accompanying resume as professional documentation of their knowledge and skills and work completed in this course.	EDD 8.1			